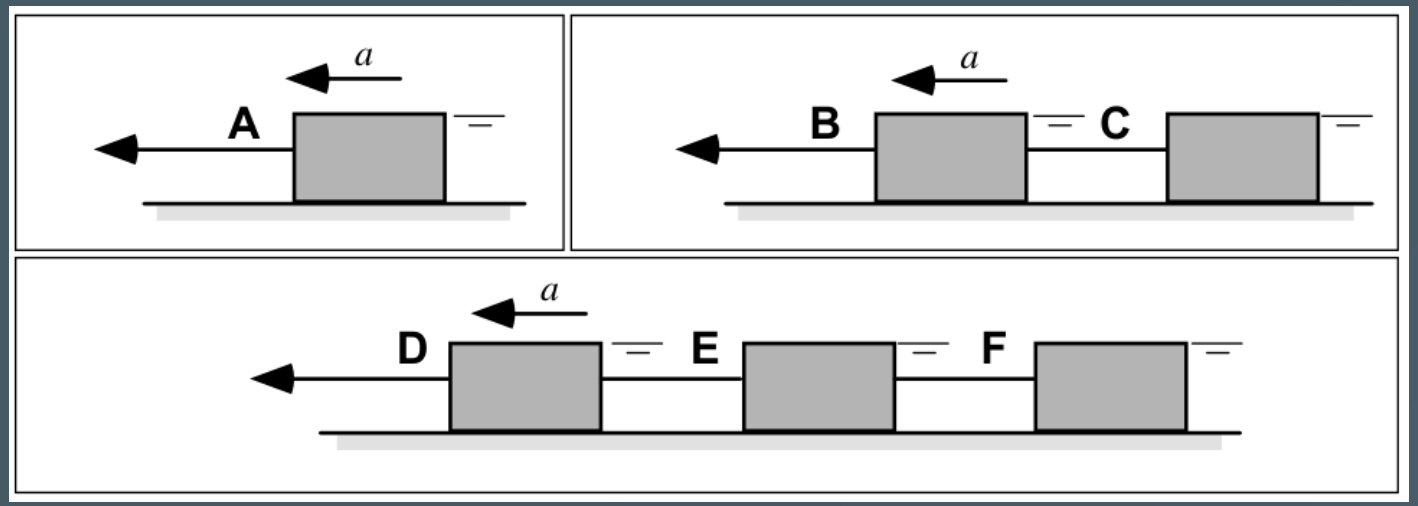
Accelerating Systems 🔨

Mr. Porter - AP Physics

Acceleration Systems



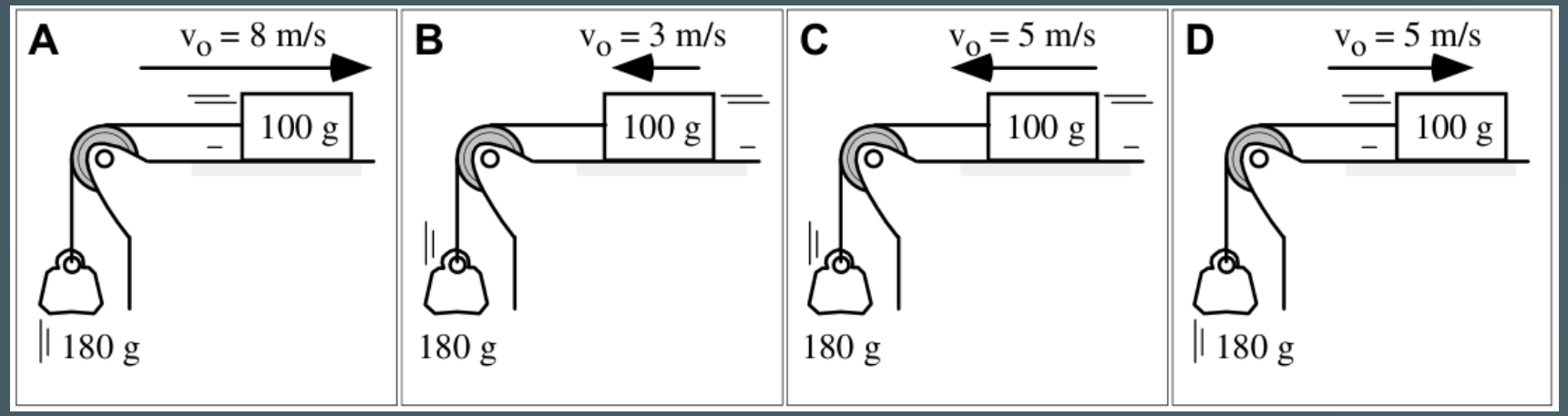
Boxes are pulled by ropes along frictionless surfaces, accelerating toward the left. All of the boxes are identical, and the accelerations of all three systems are the same.

Rank the tensions in the ropes. Explain your reasoning

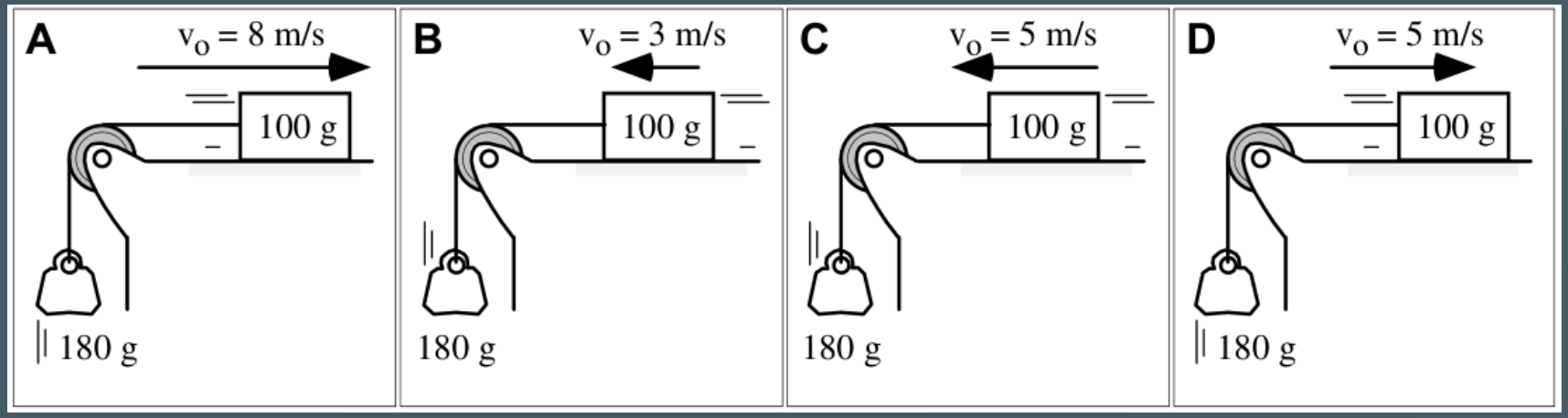
With your table

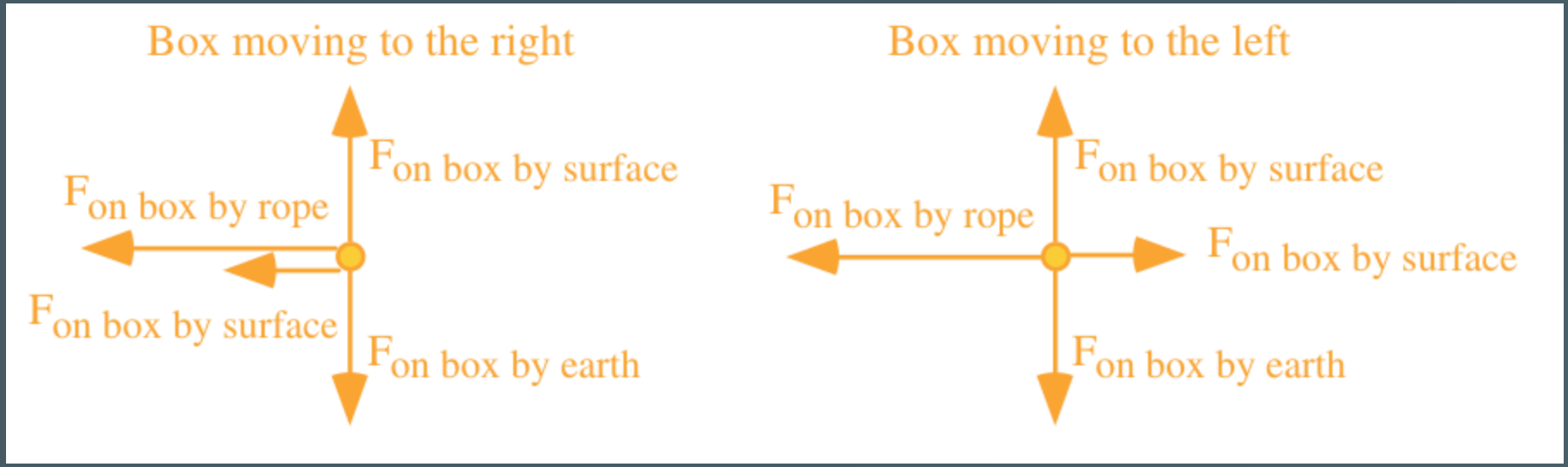
AP Workbook 2.K

In each case shown below, a box is sliding along a horizontal surface. There is friction between the box and the horizontal surface. The box is tied to a hanging stone by a massless rope running over a massless, frictionless pulley. All these cases are identical except for the different initial velocities of the boxes.



Rank the magnitudes of the accelerations of the boxes at the instant shown. Explain your ranking


A
v_o = 8 m/s
100 g
180 g
B
v_o = 3 m/s
100 g
180 g
C
v_o = 5 m/s
100 g
180 g
D
v_o = 5 m/s
100 g
180 g


Box moving to the right
$F_{on\ box\ by\ surface}$
$F_{on\ box\ by\ rope}$
$F_{on\ box\ by\ surface}$
$F_{on\ box\ by\ earth}$
Box moving to the left
$F_{on\ box\ by\ surface}$
$F_{on\ box\ by\ rope}$
$F_{on\ box\ by\ surface}$
$F_{on\ box\ by\ earth}$

Solving Modified Atwood Machines - Individual Objects

m_1:

$$\Sigma F = ma$$

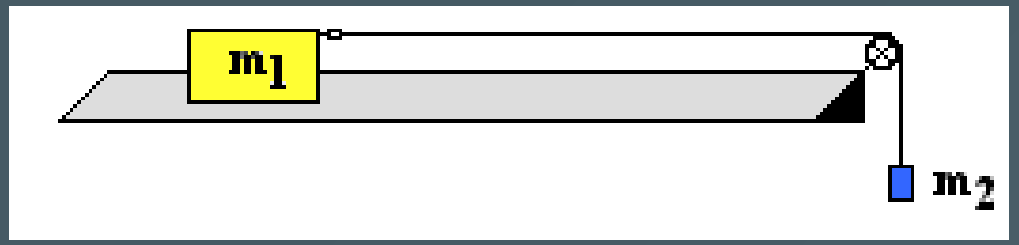
$$F_T = m_1 a$$

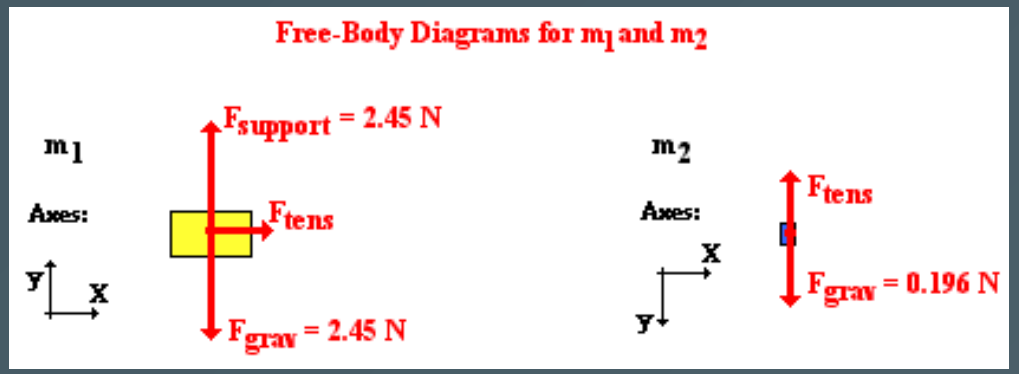
m_2:

$$\Sigma F = ma$$

$$F_g - F_T = m_2 a$$

$$m_2 g - F_T = m_2 a$$





Combine

$$m_2 g - m_1 a = m_2 a$$

$$m_2 g = (m_1 + m2)a$$

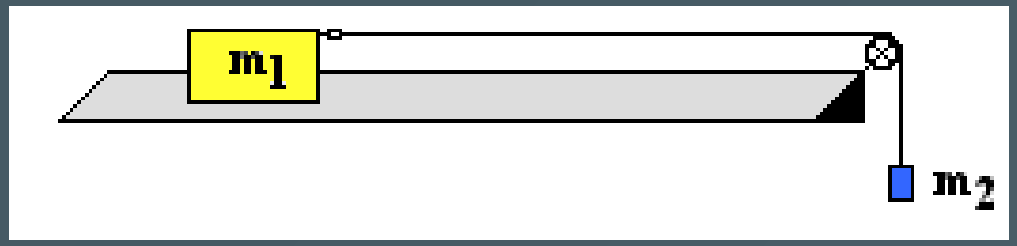
System Thinking...

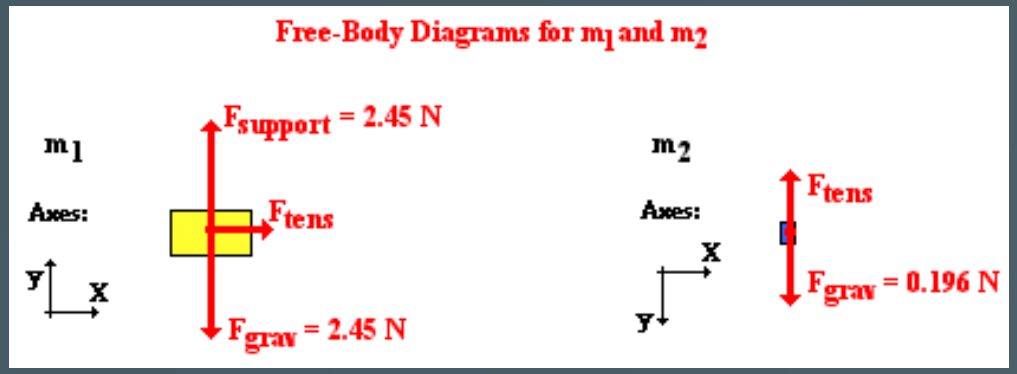
m_1 and m_2 as a system:

$$\Sigma F = m_{sys} a$$

External force is gravity:

$$m_2 g = (m_1 + m_2) a$$





Friction?

m_1:

$$\Sigma F = ma$$

$$F_T - F_f = m_1 a$$

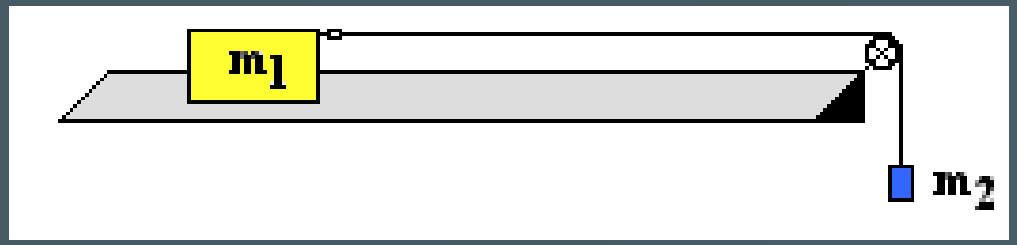
$$F_T - \mu m_1 g = m_1 a$$

m_2:

$$\Sigma F = ma$$

$$F_g - F_T = m_2 a$$

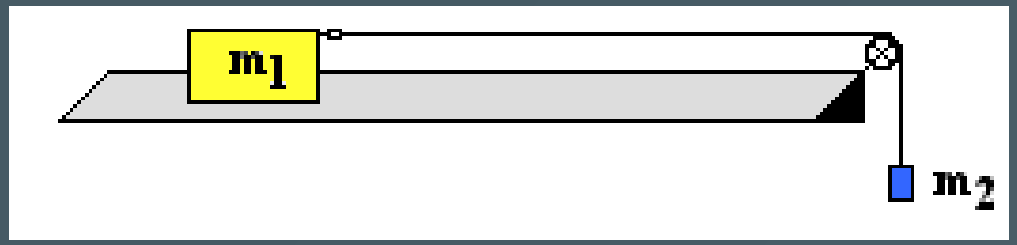
$$m_2 g - F_T = m_2 a$$



System Thinking...Friction?

m_1 and m_2 as a system:

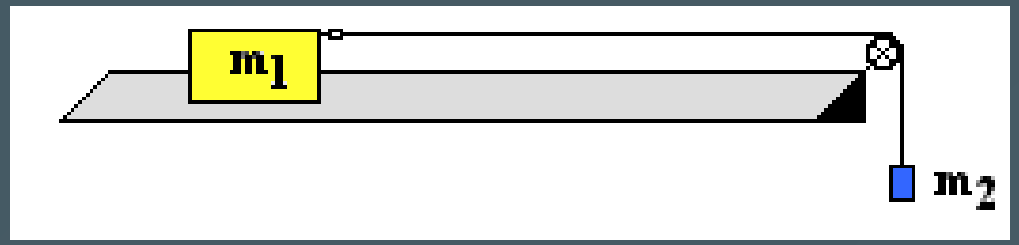
$$\Sigma F = m_{sys} a$$



External force is gravity and Friction:

$$m_2 g - \mu m_1 g = (m_1 + m_2) a$$

Self Practice



Consider the two-body situation above. A 100.0-gram hanging mass (m_2) is attached to a 325.0-gram mass (m_1) at rest on the table. The coefficient of friction between the 325.0-gram mass and the table is 0.215. Determine the acceleration of the system and the tension in the string.

Physics Classroom Practice

https://www.physicsclassroom.com/calcpad/launch/CPF2D14